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ROOTROTS OF CEREALS

Rootrots are diseases of the root system and lower portions of the stems, just as rusts and smuts are diseases of the leaves and head. The condition commonly referred to as rootrot is rather a complex one, however, and cannot always be determined with certainty. Alkali injury and wireworm damage are often confused with the true rootrots. The amount of damage caused each season in the three Prairie Provinces varies a great deal and is difficult to estimate. Diseased crops may be reduced in yield and grade. It is generally recognized, however, that root diseases cause considerable loss. The rootrots are caused by parasitic fungi, and three distinct types are known, namely, Take-all, Browning, and Common Rootrot. It seems desirable to mention here a disease called Prematurity Blight which appears to be related to the rootrots, although this relationship has not been definitely worked out.

The Root Systems and Rootrot

When the seed of wheat, oats, barley, and certain other grains is sown, the first sign of growth is the appearance of several seminal roots. Soon the shoot appears and grows rapidly until it reaches the soil surface. By the time the fourth leaf unfolds, new roots are being formed at the crown. As the plant continues to develop, this crown root system grows rapidly and under favourable conditions soon becomes well established. Tillering takes place at this stage. Thus several important stages in the plant's development take place during the first few weeks—the production of the first roots, the growth in length as the seedling breaks through the soil, the establishment of the crown roots, and tillering. When rootrot fungi interfere with this development, the plants become diseased and show characteristic symptoms.

Take-all Rootrot

Take-all is principally a disease of wheat and is confined mainly to the park country and wooded areas. Barley and rye are seldom, and oats never, seriously injured by take-all in Western Canada. This disease may appear in rather large patches in the second or third crop after breaking; whereas, in breaking or in older fields, the affected plants are found scattered throughout the crop. The disease becomes evident from the late seedling stage through to maturity. The most characteristic symptoms are stunting of the plants, bleaching of the leaves, with blackening and decay of the roots and crowns. Frequently heads are not formed, but where formed, the grain is usually shrunken. Diseased plants are easily pulled from the soil, as the roots are decayed and brittle. Under very dry conditions only the seminal roots may be blackened, but even in such cases the yield is considerably reduced. The disease is caused by a fungus called *Ophiobolus graminis*.

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Control of Take-all

(1) If take-all appears in the second or third crop on new land, or after the land has produced crops of cultivated grasses, do not sow wheat the following year. Sow a resistant crop, such as oats, corn or flax, or else summer-fallow the field.

(2) In districts where take-all is prevalent, wheat should not be raised for several years in succession on new land. It is safer to adopt the following rotation: 1st year, breaking; 2nd year, wheat; 3rd year, oats; 4th year, wheat. This may be followed by any of the standard rotations recommended for the district.

(3) In cultivating infested fields, care should be taken to destroy volunteer wheat, barley and persistent grasses, as the fungus may live on these and spread from them to wheat.

Fig. 1—The effect of rootrot on wheat. On the right, a sheaf of 100 plants affected by take-all rootrot; on the left, a sheaf of 100 healthy plants from the same field.

Browning Rootrot

Browning rootrot is primarily a disease of wheat which is conspicuous in June in the summer-fallow crop. There is good evidence that other cereals may be affected. When the seedlings are from 4 to 7 weeks old, the lower leaves rapidly turn brownish and die. The plants appear to cease growing

and are actually greatly retarded. This rootrot usually appears in large patches, frequently involving most of the fields. Its appearance suggests the term "browning." The progress of the disease is greatly influenced by weather and cultural conditions. When the diseased seedlings are examined carefully, it will be seen that the tips of many of the crown roots are decayed. The seminal or first roots of the same plants would be severely affected also, but this is not so evident to the naked eye. Other basal parts are usually free from discoloration. Later in the season the diseased areas of the field show a thin stand. In addition, the plants are retarded and stunted. This results in a more abundant weed growth. The retarded growth delays harvesting, exposing the crop to further hazards such as rust and frost. Certain soil fungi, belonging to a group called *Pythium,* appear to be the primary cause of this rootrot.

Control of Browning Rootrot

(1) Phosphate fertilizer can be recommended for reducing the injury caused by this disease and should be used regularly on the summer-fallow crop in districts where the malady is prevalent. It is most satisfactorily applied by means of a fertilizer attachment which places the fertilizer in the drill row with the seed. Fertilizers such as triple superphosphate or ammonium phosphate can be used at rates of 20 pounds per acre in the drier areas, to 30 pounds where moisture is more abundant. If in doubt regarding the use of fertilizer, it would be advisable to write to the nearest Experimental Farm or University for full information.

(2) Barnyard manure may also be used to reduce damage from browning rootrot. It should be applied before the field is ploughed in preparation for the summer-fallow, at the rate of 10 to 12 tons per acre.

Common Rootrot

All cereal crops, wheat, oats, barley and rye, are subject to common rootrot. It appears as conspicuous brown discolorations of the roots, crowns, and stem bases. Many young seedlings are killed before reaching the surface of the soil. If the infection is severe, seedlings may be blighted at later stages. Hence blank spaces in the drill rows may be indications of this trouble. It should be remembered, however, that poor germination, uneven seeding, insect injury, and so forth, may also cause an irregular stand. In older plants attacked by common rootrot, the base of the stems and roots show brown discolorations. Frequently this will result in premature bleaching, followed by the killing of tillers or the entire plant. It should be mentioned that the common fungi associated with this type of rootrot may also attack the above-ground parts, including the head and seed. Consequently these fungi may be carried by the seed. Heavily infected seed, particularly of wheat and barley, usually shows distinct brown discolorations. Common rootrot may be caused by several different fungi, alone or in association, the most common being *Helminthosporium sativum* and species of *Fusarium.*

Control of Common Rootrot

(1) The best seed obtainable should be used. Samples containing shrivelled or discoloured grains are likely to carry root-rotting fungi, which will reduce germination and emergence. Where germination of seed is below standard, it is recommended to increase rate of seeding proportionally.

(2) Organic mercury dust treatments recommended for smut control are of use in destroying the root-rotting fungi on the seed but have little or no effect on those in the soil.

(3) Early seeding is generally preferable to late seeding, since the root-rotting fungi develop more rapidly in the soil with the higher temperatures of the advancing spring season.

(4) Deep seeding is harmful. Spring preparation of the summer-fallow for seeding should consist of shallow working, to preserve a firm moist seed-bed and to make possible a proper depth of seeding.

(5) Ample moisture in the soil appears to favour recovery of wheat from infections by the common rootrot fungi. Thus, summer-fallowing and weed control as measures in moisture conservation become important farm practices in reducing losses from common rootrot.

Prematurity Blight

It is suspected that this disease is related to the rootrots. It has been observed in wheat and oats. As the name suggests, the plants are blighted rather rapidly at about heading time, when the rest of the crop is still green. The bleached and blighted individuals are very conspicuous. The entire plant is affected, and while it is of normal size and shape, seeds are not formed. The base of the stems and roots are not noticeably discoloured. Such characteristic symptoms make it possible, as a rule, to distinguish this trouble from the well known rootrots. Observations have shown that the course of the disease is somewhat of the nature of a wilt. The exact cause of the trouble, however, is not definitely known.

In order to make observations and investigations as complete and useful as possible, investigators of the Dominion Department of Agriculture will be glad to examine diseased plant specimens and seed samples, and, when possible, would like also to visit fields showing rootrot. Write to the nearest plant pathological laboratory for further information.

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